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THE STRUCTURAL ENERGICS OF LEARNING:

A Study of

The Effect of Personality-Trend and Collective Structures

on

Reading Rate Improvement

Floyd H. Allport

Everett W. Reimer

John A. Valentine

Syracuse University

The Maxwell Graduate School of Citizenship
and Public Affairs

Washington Research Office

July 15, 1954

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THE STRUCTURAL ENERGICS OF LEARNING:
A Study of the Effect of Personality-Trend and Collective
Struct: res on Reading Rate Improvement

Floyd H. Allport and Everett W. Reimer
Maxwell Graduate School of Citizenship and
Public Affairs, Syracuse University

and John A. Valentine,
Middlebury College

The experiment described in this report was carried out in order to test certain hypotheses with respect to learning, emerging from F. H. Allport's Event-Structure Theory.* In particular, the hypotheses represent adaptations of the Structural Energrics Formula, which has received some confirmation on the basis of a series of doctoral experiments carried out under the direction of the senior author (2,3,4,5,6,7,8,9). The choice of reading rate improvement as the dependent variable of the hypotheses of the present experiment was prompted primarily by a number of methodological considerations. The hypotheses are regarded as generally applicable to all types of improvements in performance falling within the accepted definition of learning as a relatively permanent change in behavior resulting from experience.

Theoretical Background of the Hypotheses

Embodied in the hypotheses of the present experiment are a number of concepts of Event-Structure Theory. A full explanation of these concepts would fall far beyond the scope of this report, but a brief statement of

* The experiment was conducted by the Washington Research Office of the Maxwell School of Syracuse University, on the basis of a contract with the Office of Naval Research (Contract N6 onr 248 07). The hypotheses were developed by the senior author, who contributed the concepts of Event-Structure contained in them, and who also developed the major design of the experiment.

The authors are indebted to Miss Georgianna Smith for assistance on many aspects of the study.

each of them will be provided at the outset, in order that the reader will have as complete a basis as possible for the logic of the hypotheses.*

Event Structure

From the point of view of Event-Structure Theory, all phenomena are looked upon as patterns of interrelated events and the events themselves and their arrangements in time-space are considered to be a fruitful concern of the scientist. Laws of nature are therefore sought for as much in the kinematic and structural ordering of events as in relationships between quantifiable variables.

The term "event-structure" is used to denote a number of events which are observed to exhibit certain characteristic predictions relative to one another. Included in any structure, for example there will be a "primary" event which predictably initiates the series and is a necessary condition for its continued operation, a number of "in-series" events which succeed one another in a predictable order, and an "end" event, whose occurrence provides the prediction that the primary event will either recur, cease to occur, or continue to occur at a reduced energy level. As a result of the relationship between the primary event and end event of the series, a structure is regarded as a cycle of events. When interpreted in terms of energy, the primary event may be thought of as involving a certain amount of energy imbalance, which is restored to steady state or to equilibrium as a result of the other events, especially the end event. The end event is therefore spoken of as closing the cycle or structure.

* A brief introduction to the principles of Event-Structure Theory will be included in F. H. Allport, Theories of Perception and the Concept of Structure, to be published in the spring or summer of 1954 by John Wiley and Sons, Inc., New York. An article by F. H. Allport on the theory is scheduled to appear in the July, 1954, issue of The Psychological Review.

Events exhibiting these structural characteristics are presumed to occur universally in nature, at all levels of organization, and evidence of structure is provided by many different branches of science. Structure appears, for example, at the physiological level, when the events involve organs of the body (e.g., homeostatic processes), and at the societal or collective level, when the events involve different organisms (e.g., institutional behavior). Two types of structure that play a prominent role in the hypotheses of the present study are so-called personality trend structures, and collective structures.

Personality Trend Structure

Some years, ago, the senior author proposed what he termed a teleonomic approach to the study of personality (1). According to this approach, personality is regarded as the pattern of things the individual seems to be generally and CHARACTERISTICALLY TRYING TO DO while going about the varied activities making up his life. We may speak of each of these things the individual characteristically tries to do as a personality trend of the individual. An individual, for example, may have as a personality trend the tendency to try to help others. In many different situations involving other people, he will perceive a need for his assistance and he will act so as to provide this assistnace. We may presume that the meanings of "my help is needed" and "I am helping" repeat themselves frequently in the experience of the individual in connection with widely varying situations and behavior.

It is only a short step to conceive of a personality trend as a structure of neuro-physiological events which give rise to the constant and recurrent trend meanings. We can visualize the primary event of such a structure as involving an energy imbalance, or tension, which is only reduced by the occur-

rence of the appropriate end meaning event. (When this end event does occur we may say that the individual has gained closure for the cycle of events making up the trend structure.)

Collective Structure

Civilized human life abounds in repetitive, cyclical events, involving the behavior of two or more individuals, that meet the criteria of structure. It is useful to make a distinction between the structures of this sort that involve two individuals, and the structures that involve some number greater than two. We refer to the former as à deux collective structures and to the latter as large collective structures.

À deux collective structure. A formalized greeting between two people on the street, in which first one and then the other says "hello," is a simple example of an à deux structure. The behavior of the first individual provides a prediction of what the second individual will do, and once the latter has responded this particular cycle is closed and both individuals are free to move on to other behaviors.

It is obvious that any personal relationship will include many recurrent cycles or structures of behavior. Two friends, for example, may behave predictably relative to one another, with respect to the specific services provided, the topics of interest shared, the activities engaged in together, and the emotional needs that are satisfied. For convenience, we may loosely refer to the aggregate of all the structures involved in a personal relationship as the à deux structure for the two individuals concerned. It should be pointed out in way of caution, however, that when we use the term structure in this sense we are still referring to the various series of behaviors which relate the two

individuals, and not to the individuals themselves, nor to some entity-like relationship between them.

Large Collective Structure. Any predictable series of behaviors, involving more than two individuals, and meeting structural criteria, we refer to as a large collective structure. The structure may consist of the behavior of members of a small committee, or small social club, or it may include the behaviors of millions of people, as in the case of a national election. Any normal adult is likely to be involved in many large collective structures, including those associated with the firm he works for, the schools he has attended, the church he attends, the political party he espouses, the clubs and associations to which he belongs and the national economic system in which he participates. It should be noted once again, however, that a collective structure refers to the inter-related behaviors of a number of individuals, and not to the aggregation or organization of individuals. A collective structure may be identified by the name of a so-called "group," but it is important to keep in mind that the structural concept and the more presently familiar "group concept" are different notions.

Structurance and Structurance Index (S)

The average individual will be involved in a number of personality-trend, a deux collective, and large collective structures; and these will, in many cases, be relatively enduring for him. As a result of the operation of each structure, certain structures within the individual, many of them at "meaning level," will be closed, and certain primary-event energy disturbances will thereby be reduced. It is these primary event energies which determine the amount of energy that the individual will expend in the structure. Until they are reduced, the individual will continue behaving in the structure, but once they

are reduced the individual's behavior in the structure will cease for the time being. Taken over a period of time, the primary event may occur only part of the time, and at varying levels of energy. Its average energy for the period, however, we may take as a convenient indication of the energy level, or "structurance," of the structure. We refer to such an average as the "structurance index" of the structure, and we designate it by the letter S.

Interstructurance and Interstructurance Index (I)

No structure of events occurs independently of other structures. It is universally to be expected that event-structures exist in relationship with one another. If one structure in its operation affects or is affected by another structure, it is said to be "interstructurant" with it. If the first structure facilitates the second structure, it is referred to as being constructurant with it; if it interferes with the second structure it is referred to as being antistructurant with it. For example, a personality trend of "trying to seek new experiences" is likely to be constructurant with a trend of "trying to enjoy life," in that the events providing closure for one trend will probably provide closure for the other as well; on the other hand, it is likely to be antistructurant with a trend of "trying to keep things as they are," since events which would serve to provide closure for it would frustrate closure for the other trend. In the same way, a railroad company would be constructurant with a factory which depends on the railroad for distribution of its products, but antistructurant with a rival trucking firm. In the former case, for example, an increase in the operation of the railroad, involving more frequent trains, more tonnage carried per train, and faster service, would probably facilitate the operation of the factory; whereas in the latter case, it would obviously

tend to cut into the operation of the trucking firm.

Interstructurance, whether of a constructurant or antistructurant sort, can be analyzed either in terms of the events that one structure shares with another structure, or in terms of events of which one structure deprives the other. As any event involves a certain amount of energy, the analysis can also be made in terms of the amount of energy that the first structure either shares with or, in a sense, takes away from the second structure. With respect to any given unit of energy in the first structure, there will be a certain probability of its either being involved in the second structure as well, or of its depriving the second structure of an equivalent unit. This probability is referred to as the Interstructurance Index of the first structure relative to the second. The greatest value this Index can have is plus one, in the case of constructurance, and minus one in the case of antistructurance. In the case of a structure that is not interstructurant at all with another structure, its Interstructurance Index relative to that structure would of course be zero. The Interstructurance Index is designated by the letter I.

In the case of any two constructurant structures, if one knew what the Interstructurance Index, or I, was for the first structure relative to the second, it would be possible to estimate the total amount of energy made available to the second structure by the first. This would be done by multiplying the Index in question (which pertains to probabilities with respect to any given unit of energy in the first structure) by the average number of energy units in that structure, that is, by its Structurance Index, or S.

In the same way, in the case of any two antistructurant structures, it would be possible to predict the amount of energy that one structure probably

loses as a result of the operation of the other structure by multiplying the (negative) I of the latter structure, relative to the former structure, by its S, or average energy.

The Structural Energics Formula

The basic operation discussed above of multiplying S and I, plays an important role in what is referred to as the Structural Energics Formula in Event-Structure Theory. This Formula has to do with the total amount of energy, or E, of any particular structure, and it takes into account, therefore, the energy the structure derives or loses as a result of its operation in what can be regarded as its total manifold of interstructurant structures.

The Formula may be expressed in mathematical terms as follows:

$$E_1 \sim S_1 + S_2 I_{21} + S_3 I_{31} + \dots + S_N I_{N1}$$

E_1 refers to the total energy of a given structure, designated as Structure 1, including any energy that is intrinsic to it and the energy it shares, by means of interstructurance, with other structures.

S_1 refers to the intrinsic energy of Structure 1. By intrinsic energy is meant the energy possessed by the structure that is independent of the structure's relationship with other structures. It may be regarded as reflecting the internal organization of the structure. It is sometimes considered to be so slight as to make its inclusion in experimental studies based on the Formula unnecessary. Finding an adequate means of measuring or estimating it is in some cases practically impossible. In any case, it was not included in the operational statement of the hypotheses of the present experiment.

Each of the other S's from S_2 to S_N , refers to the average energy of a structure, designated by the subscript, with which Structure 1 is interstruc-

urant. The total number of such interstructurant structures is designated by N. All of these structures together constitute what is called the "structural manifold" of Structure 1.

Each of the I's, from I_{21} to I_{N1} refers to the Index of Interstructurance between one of the structures in the manifold, designated by the first digit of the subscript, and Structure 1.

For purposes of experimentation based on this formula, it is convenient to regard E_1 as a dependent variable, and the sum of the SI products on the right side of the equation as an independent variable. (It should be noted that this is an algebraic sum, and that any SI product which happened to be negative -- on the basis of a minus I value -- would therefore be subtracted rather than added.) The structure designated as Structure 1 in the equation may be regarded as the "dependent variable" structure.

Previous research based on the formula has been concerned with a variety of dependent variable structures of a behavioral sort, including custom (conformity) behavior structures (9), trait rating structures (3), attitude structures (7 and 8), and English composition class structures (5). In each of these studies the independent variable was based on SI products which took into account the personality trend and collective structures of the subjects. Each study provided some confirmation of the Formula.

The Hypotheses of the Present Study

All of the hypotheses of the present study involved as a dependent variable structure a course in reading rate improvement provided by the Air Force at the Pentagon in Washington, D.C., for military and civilian employees of the Air Force, Army and Navy. Enrollment in the course is on a voluntary

basis. The course consists of hourly practice periods, five days a week, for six consecutive weeks. During the early days of the course general instruction in reading is provided, but the course consists mainly of two types of practice. One type involves reading digits flashed by a self-operated tachistoscope, to increase span of perception. The other type involves reading narrative or expository material fast enough to keep ahead of a shutter which moves down over the page at a speed set by the student. Periodic tests of: a) controlled reading rate (employing the shutter arrangement just mentioned), and b) free reading rate, are administered, the scores on these tests consisting of number of words read per minute. An objective, multiple-choice type test of comprehension accompanies each of these tests.

The choice of a reading improvement course as a dependent variable structure was prompted by several considerations. Courses of this sort were known to produce appreciable improvements in performance. Individuals taking such courses were known to differ widely in amount of improvement achieved. Objective and fairly accurate methods had been established for measuring improvement. Finally, it was possible to make the necessary arrangements for the experiment with those in charge of the Air Force reading improvement course.

Operationally the dependent variable structure was defined as the difference in words read per minute (as determined by tests of the free reading sort) during the first week and sixth week of the course. It was reasoned that an increase in words read would mean either that the neuro-physiological structures involved in successful reading, having to do with the correct perception of successive word groupings and the correct grasping of the meaningful relationships between them, were occurring with greater rapidity and frequency or that on the average each repetition of such neurophysiological structures

involved more energy. Since each structure consists of a certain amount of energy, depending on the number of events involved, any increase in the average number of such events per structure, or in the number of structures of a given energy value operating per unit of time, can be regarded as indicative of an increase in the energy expended in the reading structures. The two principal practice structures in the reading course are designed to increase respectively the two energy dimensions, just discussed, of the reading structures. One practice structure is designed to increase the number of words grasped at a glance and the other to increase the number of glances or groups of words grasped per unit of time. It seems reasonable, therefore, to infer that an increase in the energy of the free reading structures (as measured by tests) reflects an increase in the energy of the practice structures which constitute the reading improvement course. Hence, it was decided that the difference in words read per minute at the beginning and end of the course could be regarded as a measure of the difference in the energy expended in the dependent variable structure at these two times.

Energy expended in a structure as we have defined the term can not of course be expected to show correspondence with "conscious effort." Since we include in our definition only energy units involved in "successful" or "correct" performance there may even be a negative relation between the two concepts.

Central to all the following hypotheses is the idea that differences in reading rate between the first week and sixth week of the reading improvement course are a function of differences in the energy level of the ^{"correct"} reading structures at these two times. The problem of all hypotheses, therefore, was to determine what it is that underlies differences in amount of energy expended in these structures at Time 1 (the first week of the course) and Time 2 (the sixth

week of the course). This problem was approached in two different ways, on the basis of Event-Structure Theory. Hypotheses embodying one approach are referred to as Class I Hypotheses; those embodying the other approach are referred to as Class II Hypotheses.

Class I Hypotheses

The Logic of Class I Hypotheses

A strict interpretation of the Structural Energics Formula would suggest that the energy expended in the reading improvement structure at either Time 1 or Time 2 is a function of the energy available to this structure as a consequence of its interstructuranc with other structures in which the individual can be predicted to be operating. If these other structures are presumed to consist mainly of personality trend, à deux collective and large collective structures, the hypotheses would be that the energy expended in the reading improvement structure at any given time is a function of the sum of the products obtained by multiplying the Structuranc Index (S) of the individual for each structure of the types mentioned (personality trend, à deux collective, and large collective) by the Interstructuranc Index (I) of that structure relative to the reading improvement structure* Expressed mathematically

$$E_R \sim \sum(S_T I_{TR}) + \sum(S_D I_{DR}) + \sum(S_C I_{CR})$$

E_R equals the energy expended by the individual in the reading improvement structure (Structure R).

S_T refers to the potency of involvement** of the individual in each of his personality trend structures, taken separately.

I_{TR} refers to the Interstructuranc Index of each personality trend structure relative to the reading improvement structure.

* This hypothesis, although not regarded as an integral part of the study, was tested, and the results of this testing are given in the section on results.

** Potency of Involvement as used here is synonymous with Structuranc Index.

$\Sigma(S_T I_{TR})$ refers to the sum of the products of S and I, taking each personality trend structure in turn.

S_D refers to the potency of involvement of the individual in each of his à deux structures, taken separately.

I_{DR} refers to the Interstructurance Index of each à deux structure relative to the reading improvement structure.

$\Sigma(S_D I_{DR})$ refers to the sum of the products of S and I, taking each à deux structure in turn.

S_C refers to the potency of involvement of the individual in each of his large collective structures, taken separately.

I_{CR} refers to the Interstructurance Index of each large collective structure relative to the reading improvement structure.

$\Sigma(S_C I_{CR})$ refers to the sum of the products of S and I, taking each large collective structure in turn.

~ signifies "covaries with."

This hypothesis leads naturally, by a process of algebra, to the basic hypothesis of Class I, which may be stated mathematically as follows:

Hypothesis I-A (all structures combined)

$$E_{R_{t2}} - E_{R_{t1}} \sim \left[\Sigma(S_T I_{TR}) + \Sigma(S_D I_{DR}) + \Sigma(S_C I_{CR}) \right]_{t2} - \left[\Sigma(S_T I_{TR}) + \Sigma(S_D I_{DR}) + \Sigma(S_C I_{CR}) \right]_{t1}$$

in which

t1 refers to Time 1, and t2 refers to Time 2.

It will be noted that this hypothesis implies that any change in S_R from Time 1 to Time 2 will be accompanied by, and determined by, a corresponding change in ΣSI for the structures with which Structure R is interstructurant. Logically, this latter change could come about in one or more of three ways: a) the manifold of structures could change, with some structures dropping out, and some being added; b) the S of structures which happen to be in the manifold at both Time 1 and Time 2 could increase or decrease from Time 1 to Time 2; and c) the I of these structures, relative to Structure R,

could increase or decrease from Time 1 to Time 2.

The latter possibility, of a shift in I from Time 1 to Time 2, seemed most likely and most provocative, as it corresponded with the notion that an organism expends more energy in an activity (structure) when it perceives this activity as having greater relevance (interstructurance) to some of its regular, on-going activities (structures).

In order to see what effect each of the two basic types of manifold structures (personality trend and collective structures), and each of the two types of collective structure (à deux and large collective), had on the dependent variable, four additional sub-hypotheses of Class I were formulated, each one consisting of a portion of Hypothesis I-A, and therefore not expected to be confirmed as significantly as Hypothesis I-A.

Hypothesis I-B (restricted to personality trend structures)

$$E_{R_{t2}} - E_{R_{t1}} \sim [\Sigma(S_{T I TR})]_{t2} - [\Sigma(S_{T I TR})]_{t1}$$

Hypothesis I-C (restricted to collective structures)

$$E_{R_{t2}} - E_{R_{t1}} \sim [\Sigma(S_{D I DR}) + \Sigma(S_{C I CR})]_{t2} - [\Sigma(S_{D I DR}) + \Sigma(S_{C I CR})]_{t1}$$

Hypothesis I-D (restricted to à deux collective structures)

$$E_{R_{t2}} - E_{R_{t1}} \sim [\Sigma(S_{D I DR})]_{t2} - [\Sigma(S_{D I DR})]_{t1}$$

Hypothesis I-E (restricted to large collective structures)

$$E_{R_{t2}} - E_{R_{t1}} \sim [\Sigma(S_{C I CR})]_{t2} - [\Sigma(S_{C I CR})]_{t1}$$

In all the above hypotheses, the dependent variable is defined as the difference between $E_{R_{t1}}$ and $E_{R_{t2}}$, and the independent variable is the difference between ΣSI_{t1} and ΣSI_{t2} . It was decided to formulate a corresponding set of hypotheses

in which the dependent variable was defined as the ratio between $E_{R_{t2}} - E_{R_{t1}}$ and $E_{R_{t1}}$, and the independent variable was defined as the ratio between $\Sigma SI_{t2} - \Sigma SI_{t1}$ and ΣSI_{t1} . This decision was prompted by the thought that a ratio measure of the variables might serve to compensate for constant errors associated with measures derived for particular subjects. It resulted in the following additional hypotheses falling within Class I.

Hypothesis I-F (all structures combined)

$$\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}} \sim \frac{\left[\Sigma(S_{T I_{TR}}) + \Sigma(S_{D I_{DR}}) + \Sigma(S_{C I_{CR}}) \right]_{t2} - \left[\Sigma(S_{T I_{TR}}) + \Sigma(S_{D I_{DR}}) + \Sigma(S_{C I_{CR}}) \right]_{t1}}{\left[\Sigma(S_{T I_{TR}}) + \Sigma(S_{D I_{DR}}) + \Sigma(S_{C I_{CR}}) \right]_{t1}}$$

Hypothesis I-G (restricted to personality trend structures)

$$\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}} \sim \frac{\left[\Sigma(S_{T I_{TR}}) \right]_{t2} - \left[\Sigma(S_{T I_{TR}}) \right]_{t1}}{\left[\Sigma(S_{T I_{TR}}) \right]_{t1}}$$

Hypothesis I-H (restricted to collective structures)

$$\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}} \sim \frac{\left[\Sigma(S_{D I_{DR}}) + \Sigma(S_{C I_{CR}}) \right]_{t2} - \left[\Sigma(S_{D I_{DR}}) + \Sigma(S_{C I_{CR}}) \right]_{t1}}{\left[\Sigma(S_{D I_{DR}}) + \Sigma(S_{C I_{CR}}) \right]_{t1}}$$

Hypothesis I-J (restricted to a deux structures)

$$\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}} \sim \frac{\left[\Sigma(S_{D I_{DR}}) \right]_{t2} - \left[\Sigma(S_{D I_{DR}}) \right]_{t1}}{\left[\Sigma(S_{D I_{DR}}) \right]_{t1}}$$

Hypothesis I-K (restricted to large collective structures)

$$\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}} \sim \frac{\left[\Sigma(S_{C I_{CR}}) \right]_{t2} - \left[\Sigma(S_{C I_{CR}}) \right]_{t1}}{\left[\Sigma(S_{C I_{CR}}) \right]_{t1}}$$

Class II Hypotheses

Logic of Class II Hypotheses

Class II Hypotheses attempt to incorporate within the framework of the Structural Energetics Formula possible effects of practice on the energy of a structure.

If it is assumed that the energy of a structure increases with practice it may be that such an increase is not accompanied by corresponding changes in the average S or I of structures with which the structure in question happens to be immediately interstructurant. It may be argued that practice (i.e., operation of the structure) will result in increased energy of the structure even if these S and I values do not change during the practice period. Since it is impossible to conceive of the structure operating in isolation, however, it must be presumed that its interstructurance with other structures will affect the practice in some way. It is reasonable to assume that the greater the energy available through interstructurance the more effective the practice will be on the ground that the increase in energy which a structure derives through practice should be proportional to the energy available for its operation in practice. The hypothesis emerging from this line of reasoning was that increments in energy from one practice period to a subsequent one would be a function of the sum of the SI products for the structures in its manifold. Implicit in this hypothesis was the assumption that the manifold itself would stay relatively intact during the practice trials, with little change in the ongoing S and I values. For the purpose of this hypothesis, measures of S and I taken during the practice period could be regarded as estimates of the average amount of energy available for the operation of the dependent variable structure during the practice periods.

The basic hypothesis of Class II, taking all manifold structures into account and taking the dependent variable as $E_{R_{t2}} - E_{R_{t1}}$, was formulated mathematically as follows:

Hypothesis II-A (all structures combined)

$$E_{R_{t2}} - E_{R_{t1}} \sim \frac{[\sum(S_{TTR}) + \sum(S_{DDR}) + \sum(S_{CCR})]_{t1} + [\sum(S_{TTR}) + \sum(S_{DDR}) + \sum(S_{CCR})]_{t2}}{2}$$

The following sub-hypotheses, employing the same dependent variable, but restricted to particular classes of structures in the manifold, were also formulated:

Hypothesis II-B (restricted to personality trend structures)

$$E_{R_{t2}} - E_{R_{t1}} \sim \frac{[\sum(S_{TTR})]_{t1} + [\sum(S_{TTR})]_{t2}}{2}$$

Hypothesis II-C (restricted to collective structures)

$$E_{R_{t2}} - E_{R_{t1}} \sim \frac{[\sum(S_{DDR}) + \sum(S_{CCR})]_{t1} + [\sum(S_{DDR}) + \sum(S_{CCR})]_{t2}}{2}$$

Hypothesis II-D (restricted to à deux collective structures)

$$E_{R_{t2}} - E_{R_{t1}} \sim \frac{[\sum(S_{DDR})]_{t1} + [\sum(S_{DDR})]_{t2}}{2}$$

Hypothesis II-E (restricted to large collective structures)

$$E_{R_{t2}} - E_{R_{t1}} \sim \frac{[\sum(S_{CCR})]_{t1} + [\sum(S_{CCR})]_{t2}}{2}$$

Corresponding hypotheses were also formulated taking the dependent variable as the ratio between $E_{R_{t2}} - E_{R_{t1}}$ and $E_{R_{t1}}$.

Hypothesis II-F (all structures combined)

$$\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}} \sim \frac{\left[\sum (S_{T I_{TR}}) + \sum (S_{D I_{DR}}) + \sum (S_{C I_{CR}}) \right]_{t1} + \left[\sum (S_{T I_{TR}}) + \sum (S_{D I_{DR}}) + \sum (S_{C I_{CR}}) \right]_{t2}}{2}$$

Hypothesis II-G (restricted to personality trend structures)

$$\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}} \sim \frac{\left[\sum (S_{T I_{TR}}) \right]_{t1} + \left[\sum (S_{T I_{TR}}) \right]_{t2}}{2}$$

Hypothesis II-H (restricted to collective structures)

$$\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}} \sim \frac{\left[\sum (S_{D I_{DR}}) + \sum (S_{C I_{CR}}) \right]_{t1} + \left[\sum (S_{D I_{DR}}) + \sum (S_{C I_{CR}}) \right]_{t2}}{2}$$

Hypothesis II-J (restricted to a deux structures)

$$\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}} \sim \frac{\left[\sum (S_{D I_{DR}}) \right]_{t1} + \left[\sum (S_{D I_{DR}}) \right]_{t2}}{2}$$

Hypothesis II-K (restricted to large collective structures)

$$\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}} \sim \frac{\left[\sum (S_{C I_{CR}}) \right]_{t1} + \left[\sum (S_{C I_{CR}}) \right]_{t2}}{2}$$

Method

All hypotheses were tested by means of correlations between measures of reading rate improvement, the dependent variable, and corresponding independent variable measures involving S and I. Both rank-difference (τ) and product-moment (r) formulas were employed. The experiment involved a) securing as subjects some of the students enrolled in a reading rate improvement course, b) securing the measures necessary for correlational purposes, and c) computing the required correlation coefficients.

Experimental Setting and Subjects

Arrangements with the Air Force Reading Improvement Laboratory

The experiment was conducted in connection with the Air Force Reading Improvement Class 1953-F, through arrangements made with the officer in charge of reading improvement.* These arrangements included the understanding that personnel enrolled in the class in question would be given an opportunity to volunteer to participate in the experiment as subjects, that those volunteering would be assigned to particular sections of the Class, that the instruction and practice provided in these sections would be the same as that provided in regular sections, that some time in the course would be allotted to the filling out of forms, and that an extra test of free reading speed would be administered in the first week and sixth week, in order to provide a more stable average score of reading rate at Time 1 and Time 2.

* The writers wish to acknowledge their debt of gratitude to Captain Norman E. Goodwin, USAF, Chief, Reading Improvement Branch, with whom arrangements were made, to Miss Eva Mahoney, his assistant, and to other members of his staff, for their competent and generous cooperation in the experiment.

Selection of Subjects

Several weeks before the Class began, individuals who had enrolled in the course were required, as part of the regular procedure, to report to the Reading Laboratory in the Pentagon to take certain routine ophthalmographic tests. At this time they were presented with a memorandum from the Officer in Charge of the course, and one from the Director of the Syracuse University Washington Research Office, describing the experiment.

The Reading Laboratory memorandum advised members of the Class that the Reading Laboratory was cooperating with the Syracuse University Research Office in a psychological study of learning; that the research program would not in any way affect the course, but that it would require some outside work from class members interested in participating in it; that those volunteering to participate in the study would be assigned to the nine o'clock or eleven o'clock section of the class; and that the Laboratory hoped as a by-product of the research to learn ways of improving its training methods.

The Washington Research Office memorandum brought out the following points:

1. Subjects could not be told in detail about the study because of the possibility that this would affect the results.
2. Subjects would be provided afterwards with a general summary of research results, and, if interested, with a summary of data, pertaining to them personally.
3. Subjects would be asked to cooperate in two ways: a) They would be asked to fill out several questionnaires at the beginning and at the end of the course; and b) They would be asked to provide lists of individuals who knew

them well from whom information about personality characteristics might be obtained.

4. All information gained about subjects would be regarded as strictly confidential.

5. Students interested in being subjects would be expected to provide the necessary lists of acquaintances as soon as possible, and also to sign a number of authorizing form letters, to be sent to acquaintances along with the request for personality information.

A representative of the Research Office was available at the Reading Laboratory to answer questions about the experiment.

Of the 110 students enrolled in the Class, 57, or 52 per cent, volunteered to act as subjects. Complete data were secured for 47 subjects by the time the experiment was completed. Of these 47 subjects, 36 were men and 11 were women; 29 were military personnel and 18 were civilians. Occupationally the civilians ranged from clerical to high level professional; military personnel included 16 officers of field grade (major or above), 10 officers below field grade, and 3 enlisted personnel. The average age of all subjects was 38, the youngest subject being 19 years old, and the oldest subject 50 years old.

Measurement of Reading Rate (E_R)

As has been indicated, the number of words read per minute in a two-minute free reading test was taken as a measure of E_R for Time 1 and Time 2. Three such tests were administered during the first week of the course, and three presumably comparable tests were administered during the sixth week. Four of these six tests had been used interchangeably at the beginning and end of the reading course for a large number of previous classes and were known to

yield comparable reading rate gains regardless of the order of their use. Two of these four tests were used at Time 1, two at Time 2 and one new test was added to each pair. The inter-test correlations of the tests used at Time 1 were as follows: Test 1 with Test 2, $r = .89$; Test 1 with Test 3, $r = .58$; Test 2 with Test 3, $r = .57$. For the tests used at Time 2 the inter-test correlations were: Test 4 with Test 5, $r = .94$; Test 4 with Test 6, $r = .93$; Test 5 with Test 6, $r = .85$. With the exception of one test, the tests used at the beginning and at the end of the course appear to be highly consistent measures of reading rate, and we may conclude that our measures of E_{Rt1} and E_{Rt2} have satisfactory reliability. The average of the three first-week tests was taken as the measure of E_R for Time 1, and the average of the three sixth-week tests as the measure of E_R for Time 2. In the case of 3 subjects who missed one of the first-week tests, and 5 subjects who missed one of the sixth-week tests, the average was based on the two tests for which scores were available.*

Measurement of Structurance Indexes (S)

Measurement of S for Large Collective Structures (S_C)

In order to determine the Structurance Index, or S, for each subject with respect to each of his/^{large collective}structures, it was necessary first to identify the structures in which he operated regularly, and then to secure ratings of S for the structures so identified. Both of these steps were accomplished by means of a form filled out by each subject, entitled Inventory of Institutional

* Scores on comprehension tests were not used in the measurement of the dependent variable since these tests were used in the course primarily to control the rate at which subjects read. The range of comprehension scores was not great and all subjects maintained a satisfactory average of comprehension scores on the initial and final free reading tests.

Involvements.*

The form consisted of two parts. In filling out Part I of the form, the subject indicated whether or not he had any involvements of each of the following types, and if he did he briefly identified the structure or structures in question.

1. Member of the Armed Services of the United States, or employee or official of the Federal Government.
2. Employee or paid official of any other organization of any kind (business, factory, bank, corporation, etc.)
3. Real estate owner (own home, rooming house, apartment house, office building, etc.)
4. Owner or part-owner of a business (store, shop, service, factory, etc.)
5. Owner of shares or bonds in any corporation.
6. Member of a profession or occupational skill group (doctor, lawyer, engineer, teacher, nurse, carpenter, accountant, secretary, economist, statistician, artist, etc.).
7. Member of a professional or business association of doctors, lawyers, scientists, etc.; chamber of commerce, Rotary, special association of merchants, etc.)
8. Member of a trade union.
9. Member of a church.
10. Member of a religious club, society or group.
11. Member or adherent of a political party.
12. Member of a political organization other than party.
13. Member of a fraternal lodge or order.

* This form and other forms employed to secure measures of S and I for large collective, à deux, and personality trend structures were adapted from forms developed by J. Valentine and F. H. Allport for use in the former's doctoral dissertation-experiment on the structural determination of attitudes (7).

14. Member of a social, athletic, or hobby club.
15. Member of a civic group, discussion club, or welfare club or society.
16. Student in a school, member of a school alumni body, or participant in any educational group (PTA, school board, board of trustees, etc.)
17. Member of a military or veterans organization not already listed (Organized Reserve, National Guard, Veteran's Association, etc.).
18. Account with a bank, savings and loan association or similar company.
19. Insurance policy-holder.
20. Customer dependent on particular organization for significant portion of consumable goods.
21. Customer dependent on particular organization for significant portion of durable goods.
22. Client dependent on particular organization for certain services.
23. Reader or listener dependent on particular organization for significant portion of information.
24. Reader, listener or spectator dependent on particular organization for significant portion of entertainment.
25. Participant in the economic system of country (applicable to all).
26. Participant in the political system of government (applicable to all).
27. Participant in a governmental organization other than through job.
28. Participant within last six months in an organization in which not now a participant.
29. Near-future participant in an organization in which not now a participant.
30. Participant in any other organization not already listed.

After the subject had filled out Part I of the form, he filled out Part II by going back and answering the following question with respect to each collective structure listed under Part I. (The question varied somewhat depending on the nature of the structure.)

Suppose that this institution is practically certain to fold up unless something is done immediately to keep it going, and that you are offered an opportunity to do something, requiring time and energy, that would really help to keep it going. What percentage of your spare time would you give to help keep it going? Base your answer on what you would do in the next three months. Indicate your answer by encircling one of the percentages on the scale.

Remember: the percentages on the scale refer to percentages of spare time (time left over after your regular vocational duties and eating and sleeping), not of total time. The 100%, for example, represents all of your spare time.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

The percentage circled by the subject was taken as the measure of S for that particular structure.

Ratings of this sort were made for all structures during the first week and sixth week of the course. Ratings made during the first week were taken as measures of $S_{C_{t1}}$, and ratings made during the sixth week as measures of $S_{C_{t2}}$.

Measurement of S for A Deux Structures (S_D)

For the purpose of securing measures of S for the λ deux structures of the subjects, a form was employed, similar to the one just described for large collective structures, entitled Inventory of Personal Relationships. In filling out Part I of this form, the subject indicated whether he was involved in personal relationships with individuals falling in each of the following categories, and if he was so involved he recorded the initials of each such individual, for purposes of subsequent identification.

1. Wife or husband.
2. Children.
3. Mother or stepmother.
4. Father or stepfather.

5. Brothers.
6. Sisters.
7. Other blood relatives especially important to the subject.
8. Relatives by marriage especially important to the subject.
9. "Friends of the family" especially important to the subject.
10. Fiance or special friend of opposite sex.
11. Friends of either sex especially important to the subject.
12. Social acquaintances especially important to the subject.
13. Neighbors especially important to the subject.
14. Business or professional associates or colleagues especially important to the subject.
15. Individuals who might be considered as proteges of the subject.
16. Individuals especially important as teachers or counselors.
17. Individuals especially important because of some special service provided (lawyer, doctor, minister, mechanic, real estate agent, etc.).
18. Any other individuals especially important for any reason (personal, financial, professional, sentimental, social, religious, etc.).

In filling out Part II of the form, the subject answered the following question about his relationship to each individual identified in Part I.

Suppose that this relationship is practically certain to be broken off unless something is done immediately to keep it going, and that there is an opportunity for you to do something to keep it going. What percentage of your spare time would you give to keep the relationship going? Base your answer on what you would do in the next three months. Indicate your answer by encircling one of the percentages on the scale.

Note: The percentages on the scale refer to percentages of spare time, not of total time. The 100%, for example, represents all of your spare time. Make your ratings accordingly.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

The percentage that the subject encircled was taken as his Structuranc

Index for each a deux structure (S_D). Such an index was secured during the first week and again during the sixth week of the course ($S_{D_{t1}}$ and $S_{D_{t2}}$).

Measurement of S for Personality Trend Structures (S_T)

In the case of personality trend structures, it was necessary once again to obtain first a list of trend structures, and then to obtain a measure of S for each structure. Both of these steps were accomplished through acquaintances of each subject.

During his initial visit to the Reading Laboratory, several weeks before the beginning of the Class, each student who decided to participate in the experiment was provided with a form on which he was requested to list the names and addresses of fifteen individuals from whom information regarding his personality might be obtained.

In making his selection of individuals, the subject was requested to include individuals who knew him in a variety of circumstances, and in different kinds of relationships. As a guide to help him think of people who knew him in different connections, he was provided with the following list of typical categories of personal relationships. It was suggested that he try to spread his list of fifteen individuals as much as possible across these categories.

Family Relationships, including husband or wife, parents, children, brothers and sisters, other relatives, in-laws, and possible close family friends.

Vocational Relationships, including supervisors, subordinates, fellow workers and other work associates.

Religious Relationships, including members of the clergy, church officials, church workers, fellow church members, etc.

Social Relationships, including individuals known principally in connection with various social activities and functions.

Recreational or Avocational Relationships, including fellow hobbyists, sports companions and others with whom leisure time activities are shared.

Organizational Relationships, including fellow members, or officers, of a civic club, a professional group, a fraternal lodge, a school alumni group, etc.

Care and Guidance Relationships, including physicians, dentists, oculists, lawyers, or others depended on for professional care or advice.

Neighborhood Relationships, including those living near who have become known well.

Friendship Relationships, including adult friends of all ages and both sexes.

The subject was asked to try to list only those individuals who a) knew him well; b) were able to view him objectively; c) would probably be willing to give the information needed; and d) would probably be reached promptly by mail.

The subject was also asked to sign copies of the following authorizing letter, which was designed to accompany the material to be sent to each acquaintance.

Dear _____ :

I have given your name to the Washington Research Office of Syracuse University as someone who knows me and who would be able to provide them with certain information about me. They need this information for a study they are carrying out in connection with an Air Force Training course in which I am enrolled.

I have been assured that the information you are asked to give will not be disclosed to anyone in the Air Force, the Army or the Navy, or any governmental office, or to anyone at all except the few members of the Syracuse University Washington Research Office who will be concerned with its analysis.

I hope you will find it convenient to give this information, which I understand is necessary for the success of the study.

Sincerely yours,

Each acquaintance listed by a subject was mailed a form, to which a signed copy of the above letter was attached, requesting a listing of the personality trends of the subject.

In the form, it was pointed out in some detail that it is possible to describe a person in terms of what he characteristically tries to do; that most

individuals have a certain number of such "trying-to-do" tendencies which comprise, to a large measure, what is thought of as the individual's "personality." The form requested the acquaintance to list the things the subject seemed to try characteristically to do.

The acquaintance was instructed in making up his list to think of the one individual under consideration, in order to avoid slipping over to a "trait" approach; and to be as frank, objective, and unbiased as possible. He was provided with a self-addressed and stamped envelope in which to forward his completed list to the Washington Research Office.

The average number of lists submitted by acquaintances per subject was 10. For no subject were fewer than 4 lists submitted.

Statements in the lists were screened, to insure their meeting the criteria for trends. Some were rejected because they involved specific things the subject tried to do rather than general, characteristic things; and some were rejected because they weren't statements of what the subject tried to do so much as trait descriptions of his behavior.

The remaining statements were sorted into categories on the basis of similarity of meaning, and a statement was then composed to cover all statements in each category. In this way the following master list of 53 trend descriptions was developed.

Trend Descriptions

(Subject) characteristically tries to:

- | | |
|--------------------------------------|-----------------------------------|
| 1. help others | 28. gain attention |
| 2. be fair | 29. be precise |
| 3. do things efficiently | 30. be optimistic |
| 4. control himself | 31. improve things |
| 5. conserve or spare himself | 32. increase his knowledge |
| 6. enjoy life | 33. be creative |
| 7. dominate and control situations | 34. depend on others |
| 8. fulfill his obligations | 35. maintain high moral standards |
| 9. live fully | 36. be well-informed |
| 10. improve himself | 37. seek new experiences |
| 11. see humor in things | 38. be well-liked |
| 12. organize | 39. keep things neat and orderly |
| 13. make friends | 40. understand things |
| 14. gratify his sense of beauty | 41. see other viewpoints |
| 15. do things well | 42. entertain others |
| 16. influence others | 43. be comfortable |
| 17. give of himself | 44. see things in perspective |
| 18. be independent | 45. gain respect and recognition |
| 19. give affection | 46. be economical |
| 20. keep things as they are | 47. accomplish things |
| 21. reason things out | 48. be secure |
| 22. gain affection | 49. carry things to completion |
| 23. be generous | 50. indulge himself |
| 24. be on an equal basis with others | 51. advance himself |
| 25. please others | 52. excel |
| 26. do things rapidly | 53. get along well with others |
| 27. act modestly | |

A second form was then mailed to the acquaintances of each subject, requesting ratings of the percentage of spare energy that the subject seemed to the rater to spend in trying to do each of the 53 things included on the master list. The acquaintance was instructed as follows with respect to the rating of any given trend:

1. You are to make, first, a mental estimate, on the basis of your past observations of the individual named in the letter, of the percentage of his or her spare energy that he or she expends in trying to do the one thing under consideration.

2. In making the estimate, it is important that you keep in mind the fact that you are estimating the percentage of the spare energy that the individual spends. You do not have to take into account the energy that he or she has to

expend in order to meet various vocational and other responsibilities.

3. Finally, after you have made your mental estimate in this way, you are to indicate what it is by encircling one of the percentages on the scale accompanying the item. The scale will look like this:

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

The acquaintance was advised that some of the statements on the list had been suggested as applying to the subject, but that some had been obtained from the acquaintances of other subjects, so that many ratings might properly be zero. He was encouraged to be as objective as possible in his ratings.

Acquaintances were supplied with self-addressed and stamped envelopes for the purpose of returning the completed forms. The average number of acquaintances furnishing ratings per subject was 9.5. For no subject were there fewer than 5 sets of ratings.

A measure of S_T for each subject, with respect to each of the 53 trends, was obtained by taking the mean of the percentages encircled by the acquaintances of that particular subject. These ratings were made only once, before the Class began, since it was regarded as unlikely that any appreciable shifts in S_T would occur from Time 1 to Time 2. This opinion stemmed from the generally accepted view that personality tendencies become established early in life and normally remain fairly fixed. The same measures of S_T were therefore used in computing the sums of $S_{T I_{TR}}$ for Times 1 and 2.

Determinations of Interstructurance Indexes (I)

In determining Interstructurance Indexes for the various personality trend and collective structures of each subject, relative to the reading improvement structure, ratings by the subject were employed, which they were asked to make in specially prepared forms. In all cases, the ratings were in terms of

the relevance of reading rate improvement to the trend or collective structure, or in terms of the effect of reading rate improvement on the trend or collective structure, rather than vice versa, even though the Index of Interstructur-
ance derived was in terms of the trend or collective structure relative to the reading improvement structure. In other words, measures of I_{TR} , I_{DR} , and I_{CR} were based on ratings of I_{RT} , I_{RD} and I_{RC} . This was in line with previous research, in which it had been found that it was more natural and meaningful to think of interstructur-
ance as of the dependent variable structure relative to one of the manifold structures, rather than the other way around.*

In previous research, ratings of I were made by individuals other than the subject, such ratings being referred to as ratings of "objective" relevance (interstructur-
ance). In the present study it was considered necessary to use ratings of so-called "perceived" relevance made by the subjects themselves with respect to their participation in their own structures, in order to test hypotheses of Class I, which involve possible shifts in I from Time 1 to Time 2 that only the subject would be in a position to know about.

Determination of I for Large Collective Structures (I_{CR})

A form was supplied to each subject, providing him with instructions and space for making ratings of I with respect to his participation in large collective structures.

The instructions began with several examples of interstructur-
ance be-

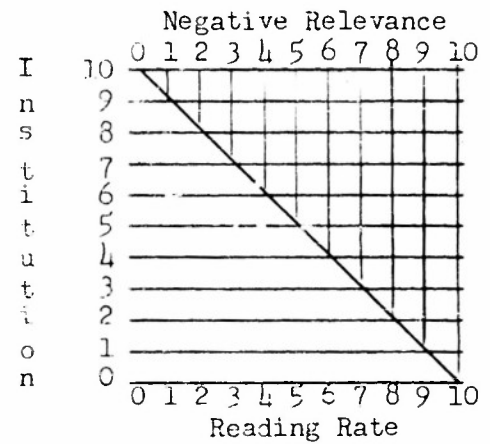
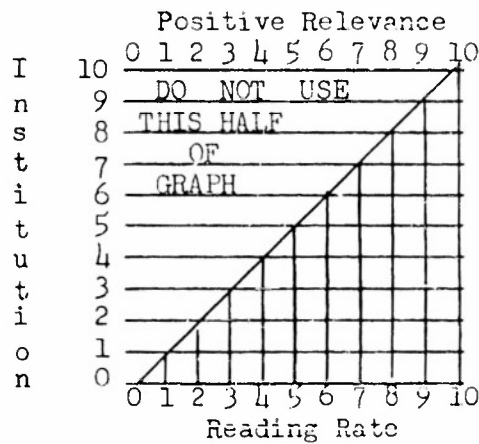
* In Event-Structure theory, when any two structures are in what is called a "system" relationship, as is the case in the present study with the reading rate improvement structure and any trend or collective structure, the Interstructur-
ance Index of each to the other is considered to be equal. For an explanation of this aspect of the theory, which lies beyond the scope of this report, the reader is referred to the publications mentioned in Footnote 2 (page 2).

tween reading rate improvement and collective structures in which the subject might be involved, in order to give the subject a general idea of the kind of ratings he was to make. The first example of positive relevance (constructur-
ance) was as follows:

Let us take as a hypothetical case a man who happens to be employed by a publishing firm, and whose job includes the reading and evaluating of many manuscripts. How might we conceive of the relevance of an improvement in his rate of reading to his participation in the publishing firm? One way of doing this would be to imagine a steady increase in his rate of reading and to visualize the effect that this would probably have, if any, on his participation in the firm, in terms of his effectiveness, achievement, etc. He is in the best position to do this, of course, because he has naturally at hand all of the pertinent information. Even looking at it from the outside, however, with our limited knowledge of the facts, it seems that in general the faster he reads the higher will be the level of his job performance. For one thing, he will be able to read more manuscripts, and for another thing he will probably have more time left over to spend on other aspects of his job. We would say, therefore, that reading rate improvement is positively relevant to this particular type of participation.

The subject was advised that he would first be asked, with respect to each of his institutions, the following basic question: "Does an increase in your rate of reading seem to be relevant, either positively or negatively, to your participation in this institution?"* If his answer to this question was yes, he was then asked to go on and answer one of two additional questions, depending on whether the relevance was judged to be positive or negative. These additional questions both referred to graphs, as follows:

* Event-Structure theory in the abstract conceives of Interstructurance as between structures per se and not as confined to the linkage between them which an individual may provide by participating in both. For purposes of this study the more restrictive form of the question was used to get an index of interstructurance because it would seem more realistic to the subject and also (in the case of this dependent variable) would be an adequate approximation of the theoretically more valid form.

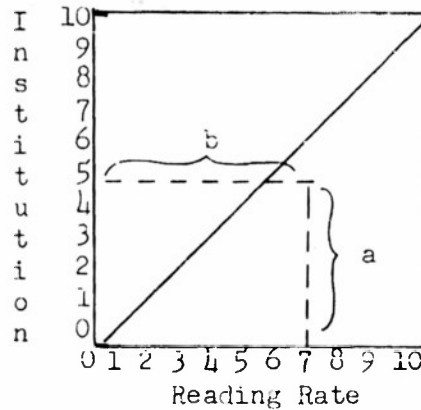


The base line of both of these graphs was described as representing progressive increases in words that could be read per minute by the subject, from zero to maximal imaginable. The vertical scale was described as representing various levels of participation in the institution, on the part of the subject, from a zero level to a maximum conceivable level.

The question pertaining to positive relevance was: "What point on the graph seems to represent the highest level of participation in this institution that you might achieve as a result of increases in your rate of reading?" In answering this question, the subject was to visualize on the graph a line or curve (referred to as a "relevance curve") representing all of the changes in level of participation in the institution that would probably be associated with increases in rate of reading, and he was to determine the point on the graph representing the highest point first reached by this curve (starting from zero).

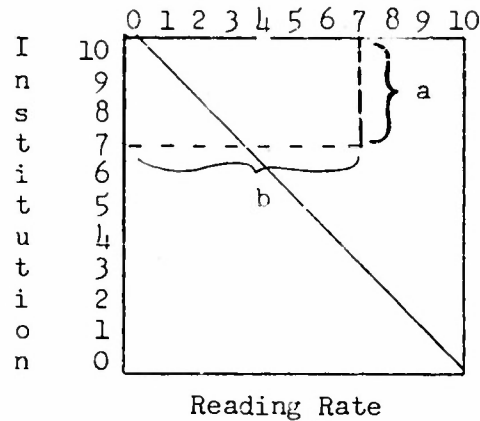
An Index of Interstructurance was derived, from the point marked on the graph by the subject, by taking the ratio between the ordinate value and abscissa value of that point. For example, if the subject were to mark a point on the graph coordinating position five on the Institution (vertical) scale and position seven on the Reading Rate (horizontal) scale, as in the figure below, his

Index would be $5/7$ (a/b in the figure).



This ratio, it will be noted, provides an indication of the proportion of energy expended in reading (as reflected in reading rate) that contributes to the energy expended in the institution (as reflected in level of participation) provided the two scales are assumed to be roughly comparable). Such a proportion corresponds with the concept of I as the probability with respect to any event (energy unit) in one of two structures that it will be involved in the other structure as well. The reason for restricting the subjects to rating half of the graph was to insure that I (a/b) would in no case exceed unity, which is of course its logical limit.

The question in the case of negative relevance was: "What point on the graph seems to represent the lowest level of participation in the institution to which you might be reduced as a result of increases in your speed of reading?" An Interstructurance Index was computed from such a point by taking the ratio between ten minus the ordinate value of the point, and the abscissa value of the point. If the point, for example, coordinated position 8 on the Reading Rate scale with position 7 on the Institution Scale, as in the figure below, its Interstructurance Index would be $3/7$ (a/b in the figure).



Ratings of the sort described were made by each subject with respect to all collective structures to which reading rate improvement was judged to have some relevance, and such ratings were made both at Time 1 and Time 2.

Determination of I for A Deux Collective and Personality Trend Structures (I_{DR} & I_T)

The procedure for securing measures of I_{DR} and I_{TR} was in all essential respects comparable to the procedure just described for securing measures of I_{CR} . A form was employed which contained examples of the relevance in question, and which explained the basic relevance question, the positive and negative relevance questions, and the graphs which were to be used in connection with the latter two.

In the case of the personal relationship (à deux) form, the vertical scale of the graphs was described as presenting levels of operation of the relationship under consideration. The three questions asked the subject were as follows:

Question I Does an increase in your rate of reading seem to be relevant, either positively or negatively, to this relationship?

Question II (Answered only in case of positive relevance) What point on the graph seems to represent the highest level of operation of this relationship that would result from increases in your rate of reading?

Question III (Answered only in case of negative relevance) What point on the graph seems to represent the lowest level of operation of the relationship

that would result from increases in your speed of reading?

In the case of the form for measuring the relevance of reading rate improvement to personality trend structures, trends were interpreted as personal values, and the task was stated as that of judging the relevance of reading rate improvement to the actualization of certain values. It was believed that the subject would be able to take a more detached and objective view of his own trends if he were to think of them in terms of values which he tried to achieve rather than in terms of personal tendencies. The vertical scale of the positive and negative relevance graphs was described as representing various degrees of actualization of the value under consideration. The three questions were stated as follows:

Question I (Answered for each value) Would an increase in your rate of reading seem to be relevant, positively or negatively, to your actualization of this value?

Question II (Answered only in case of positive relevance) What point on the graph seems to represent the highest level of actualization of the value that you would achieve as a result of increases in your rate of reading?

Question III (Answered only in case of negative relevance) What point on the graph seems to represent the lowest level of actualization of the value that would result from increases in your rate of reading?

Interstructurance Indexes for à deux structures and personality trend structures were computed in the way described for large collective structures.

Results

Once the necessary measures of reading rate (E_R), Structuranc Index (S_T, S_D, S_C), and Interstructuranc Index (I_{TR}, I_{DR}, I_{CR}) were available, for Time 1 and Time 2, it was possible to establish the dependent and independent variable arrays appropriate for the correlational testing of each of the hypotheses. The operations involved are fairly self-evident, except possibly for ΣSI , and we shall therefore indicate briefly how this term in the independent variable was arrived at, using $\Sigma(S_C I_{CR})$ as an illustration.

The large collective structures of each subject were first listed in a column. The Structuranc Index, S_C , for each structure was then recorded in an adjoining column, on the row for that structure. In a third column measures of I_{CR} were recorded. The product of S_C and I_{CR} was then computed for each structure and recorded on the row for that structure in a fourth column. The sum of the products in this final column was then computed, yielding $\Sigma(S_C I_{CR})$. The same method was used for computing ΣSI for à deux collective $\Sigma(S_D I_{DR})$ and personality trend $\Sigma(S_T I_{TR})$ structures.

In Table I are recorded the means, standard deviations and coefficients of variation of the reading rate measures used in the testing of hypotheses of Class I and Class II.

Table I

Means (M), standard deviations (SD), and coefficients of variation (V) of the distributions of variables participating in or employed as the dependent variables of Class I and Class II hypotheses.

N = 47

Variable	M	SD	V
$E_{R_{t1}}$	283	65	.23
$E_{R_{t2}}$	484	143	.30
$E_{R_{t2}} - E_{R_{t1}}$	201	102	.51
$\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}}$.7	.302	.43

In general, it will be noted with respect to these distributions that their variability is sufficient for correlational purposes. There are obvious grounds, however, for doubting that the distributions show as much variability as would be the case if they were based on a sample drawn from a less restricted population.

In Table II, the tau^{*} coefficients of correlation between the reading rate measures are presented. There will be occasion to refer to these coefficients in subsequent discussion of the results. In passing, it may be noted that a positive coefficient, significant at the .001 level of confidence, is obtained between reading rate at Time 1 and Time 2, and that reading rate at Time 1 correlates positively with $E_{R_{t2}} - E_{R_{t1}}$ (significant at .05 level), but negatively with $\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}}$ (not significant). The latter negative correla-

* Reference throughout is to Kendall's tau coefficient.

tion between initial reading rate and relative reading gain demonstrates that use of relative gain as a dependent variable seems to compensate for the effect of individual differences in reading ability or improvement in the course. It will be recalled that this was the reason for including it in hypotheses of both Class I and Class II.

Table II

Tau coefficients of correlation between the variables participating in or employed as dependent variables of Class I and Class II hypotheses.

N = 47				
Variable	E_{Rt1}	E_{Rt2}	$E_{Rt2} - E_{Rt1}$	$\frac{E_{Rt2} - E_{Rt1}}{E_{Rt1}}$
E_{Rt1}		.49**	.20*	-.10
E_{Rt2}			.71**	.41**
$E_{Rt2} - E_{Rt1}$.70**

* significant at the .05 level.

** significant at the .001 level.

In Table III are given the means, standard deviations, and coefficients of variation of the variables either participating in or employed as independent variables. It will be noted that the variability of all of these distributions is of sufficient magnitude to make correlational analysis feasible. The variability in each case, however, is probably less than it would have been if the subjects had been drawn from a population less homogeneous with respect to personality trend and collective structures. The fact that all subjects were employed by the Defense Department introduced certain collective structures in common; and the fact that all of them applied for the reading improvement

course and volunteered to act as subjects in the present experiment makes it likely that they are at least somewhat homogeneous with respect to personality trends.

Table III

Means (M), standard deviations (SD), and coefficients of variation (V), of the distributions of variables participating in or employed as independent variables of Class I and Class II hypotheses. N = 47

Variable	Structures included in variable	M	SD	V
ΣSI_{t1}	TDC	167	89	.53
	T	108	59	.54
	DC	58	47	.81
	D	33	38	1.16
	C	26	15	.60
ΣSI_{t2}	TDC	166	114	.69
	T	108	71	.66
	DC	58	52	.89
	D	31	37	1.17
	C	27	20	.65
$\Sigma SI_{t2} - \Sigma SI_{t1}$	TDC	-1	63	*
	T	0	36	
	DC	0	39	
	D	-2	30	
	C	1	13	
$\frac{\Sigma SI_{t2} - \Sigma SI_{t1}}{SI_{t1}}$	TDC	-.04	.36	*
	T	-.05	.45	
	D	.14	2.47	
	C	.10	.68	
$SI_{t1} + SI_{t2}$	TDC	333	194	.58
	T	216	63	.29
	DC	118	91	.77
	D	64	34	.53
	C	54	17	.31

* The coefficient of variation is not an appropriate statistic for this distribution.

Tau coefficients of correlations with respect to various combinations of ΣSI , our independent variable measures, are reported in Table IV. These coefficients will be referred to in subsequent discussion of the results. To be noted are the high positive correlations between ΣSI_{t1} and ΣSI_{t2} for all structures combined and for separate classes of structures, and also the high positive correlations between the measures of ΣSI_{t1} for trend, à deux, and large collective structures.

All distributions of dependent and independent variables were inspected and found to be approximately symmetrical and mesokurtic.

Table IV

Tau coefficients of correlation between certain of the variables participating in or employed as independent variables of Class I and Class II hypotheses.

N = 47

Variables	Tau	Level of Confidence*
ΣSI_{t1} (TDC) and ΣSI_{t2} (TDC)	.70	.001
ΣSI_{t1} (T) and ΣSI_{t2} (T)	.74	.001
ΣSI_{t1} (D) and ΣSI_{t2} (D)	.53	.001
ΣSI_{t1} (C) and ΣSI_{t2} (C)	.62	.001
ΣSI_{t1} (T) and ΣSI_{t1} (D)	.38	.001
ΣSI_{t1} (T) and ΣSI_{t1} (C)	.43	.001
ΣSI_{t1} (D) and ΣSI_{t1} (C)	.33	.01
ΣSI_{t1} (TDC) and $\Sigma SI_{t2} - \Sigma SI_{t1}$ (TDC)	.00	
ΣSI_{t1} (TDC) and $\frac{\Sigma SI_{t2} - \Sigma SI_{t1}}{\Sigma SI_{t1}}$.19	

* The terms "level of confidence" and "level of significance" have been used interchangeably in the tables and text. The figures given in the tables all indicate levels of significance. Confidence limits can be computed from the data presented and from the standard deviations shown below of distributions of our correlational indexes. $\sigma_{\text{tau}} = .10$ $\sigma_r = .15$

In the testing of Class I and Class II hypotheses both tau and product-moment coefficients were employed. Tau coefficients were used throughout the analysis of the data because of the speed with which they could be computed.* They were used jointly with product-moment coefficients in the case of the hypotheses to provide an independent measure of correlation, which would not be subject to the assumptions with respect to normality and homoscedasticity implicit in the case of r , and which would not be unduly influenced by cases at the extreme ends of the distributions.

In Table V are recorded the tau and r coefficients of correlation for all twenty hypotheses. We shall discuss these coefficients first with reference to hypotheses of Class I, and then with reference to hypotheses of Class II. It will be recalled that five of the hypotheses of each class employed absolute gains in reading rate as a dependent variable, and five employed relative gain, and that within each such group of five there was a major hypothesis which took into account all structures in the manifold, and four sub-hypotheses which were restricted to particular types of structure.

* The method for computing tau proposed by Harold F. Bright of the Human Resources Research Office of George Washington University was employed and found to be extremely time-saving. A description of the method is given in a Staff Memorandum of the Office in question.

Table V

Product-moment and/or tau coefficients between the dependent variable and independent variable of each of 20 hypotheses. Level of confidence achieved is indicated for all coefficients achieving at least the .05 level. N = 47.

Hypotheses				Coefficients of Correlation, and levels of confidence achieved for both coefficients			
Designation	Dependent Variable	Independent Variable	Structures Included	Tau	r	Level of Confidence tau	r
I-A	$E_{R_{t2}} - E_{R_{t1}}$	$\Sigma SI_{t2} - \Sigma SI_{t1}$	TDC	-.09			
I-B	"	"	T	-.02			
I-C	"	"	DC	-.07			
I-D	"	"	D	-.07			
I-E	"	"	C	-.11			
I-F	$\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}}$	$\frac{\Sigma SI_{t2} - \Sigma SI_{t1}}{\Sigma SI_{t1}}$	TDC	.12	.22		
I-G	"	"	T	.14	.14		
I-H	"	"	DC	.06			
I-J	"	"	D	.08	.15		
I-K	"	"	C	-.10	-.10		
II-A	$E_{R_{t2}} - E_{R_{t1}}$	$\frac{\Sigma SI_{t1} + \Sigma SI_{t2}}{2}$	TDC	.21	.25	.05	
II-B	"	"	T	.19	.25		
II-C	"	"	DC	.11	.19		
II-D	"	"	D	.07	.17		
II-E	"	"	C	.11	.13		
II-F	$\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}}$	$\frac{\Sigma SI_{t1} + \Sigma SI_{t2}}{2}$	TDC	.33	.45	.01	.01
II-G	"	"	T	.25	.41	.02	.01
II-H	"	"	DC	.25	.36	.02	.02
II-J	"	"	D	.20	.32	.05	.02
II-K	"	"	C	.19	.27		

Results of Testing Class I Hypotheses

Class I Hypotheses with $E_{R_{t2}} - E_{R_{t1}}$ as a Dependent Variable

The first five hypotheses of Class I, Hypotheses I-A through I-E, are all variations of the general hypothesis that reading rate improvement, regarded as the difference between reading rates at Time 1 and Time 2, is dependent on a difference in ΣSI for the two times. Hypothesis I-A is the basic hypothesis of this group, since it takes into account all three types of structure (personality trend, \grave{a} deux collective, and large collective). The tau and r coefficients in the case of this hypothesis are close to zero and tend to be negative, and the same thing is true for the sub-hypotheses. The hypotheses are clearly not confirmed.

In the earlier discussion of these hypotheses, it was mentioned that they are derived from a general hypothesis that reading rate at any given time is itself a function of ΣSI . This hypothesis was tested for Time 1 and Time 2; the tau coefficients (not reported in a table) for all structures combined, were $-.08$ for $E_{R_{t1}}$ and ΣSI_{t1} , and $-.04$ for $E_{R_{t2}}$ and ΣSI_{t2} . As indicated in the earlier discussion, failure of the general hypothesis in question does not rule out confirmation of Hypotheses I-A -- I-E, but makes such confirmation unlikely.

According to the unsubstantiated predictions made in Hypotheses I-A -- I-E we would expect that the increases in reading rate, which occurred for all subjects, would be accompanied by increases in ΣSI . For approximately half of the subjects, however, there was a decrement rather than an increment in ΣSI for Time 1 to Time 2. (Table III, note M and SD for $\Sigma SI_{t2} - \Sigma SI_{t1}$.)

Class I Hypotheses with $(E_{R_{t2}} - E_{R_{t1}})/E_{R_{t1}}$ as a Dependent Variable.

The second five hypotheses of Class I, Hypotheses I-F -- I-K, differ from

the first five, Hypotheses I-A -- I-E, in that the dependent variable is in terms of relative gain rather than absolute gain. The coefficients for Hypothesis I-F, the basic hypothesis of this group, are positive and achieve the .10 level of confidence. The coefficients for the four sub-hypotheses are not significant, and those for Hypothesis I-H are negative.

It should be noted that, due to the ratios employed in the dependent and independent variables of these hypotheses, positive correlations could be expected if it were found that ΣSI_{t1} correlated positively with ΣSI_{t2} , and either or both of these terms correlated with $\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}}$. We have seen that the tau coefficient of correlation between ΣSI_{t1} and ΣSI_{t2} is .70 (Table IV). The tau coefficient between ΣSI_{t1} and $\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}}$ is .40, and that between ΣSI_{t2} and $\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}}$ is .42, as shown in Table VII. The positive correlation in the case of Hypothesis I-F is thus possibly the result of these correlations, which do not pertain to the logic of the hypothesis.

In view of the coefficients reported in Table V, and in view of the above remark with respect to the coefficients relating to the terms of Hypothesis I-F, we can conclude that Hypotheses I-F -- I-K, are not confirmed by our data.

Summary Statement of Results for Class I Hypotheses

The results indicate that for the subjects and circumstances of this experiment, reading rate improvement, whether measured in terms of absolute gain or relative gain in words read per minute, is not a function of increases in ΣSI from the first week to the last week of the reading improvement course. It is possible, of course, that the hypothesis is valid but that our methods were not adequate for its demonstration.

Results of Testing Class II Hypotheses

Class II Hypotheses with $E_{Rt2} - E_{Rt1}$ as a Dependent Variable

It will be noted first with respect to the coefficients in Table V reported for Hypotheses II-A -- II-E, in all of which absolute gain in words read is taken as the dependent variable, that all coefficients are positive. It will be noted also that the coefficients for Hypothesis II-A, the basic hypothesis of this group, which includes all manifold structures, are generally higher than those for the sub-hypotheses. Only one of the coefficients achieves an acceptable level of confidence, however, and we can not infer from them with any degree of certainty that the hypotheses are confirmed.

It is of interest to note that when ΣSI for Time 1 and ΣSI for Time 2 are correlated separately with the dependent variable the coefficients for Time 1 are slightly higher and those for Time 2 slightly lower than coefficients based on combined or average ΣSI values. It will be seen that two of the coefficients, TDC and T, for Time 1 correlations are significant at the .05 level. These coefficients are reported in Table VI. It should also be noted that the highest coefficients are yielded when all manifold structures are combined, which is consistent with the logic of Event-Structure theory. The coefficients for trend structures are consistently higher than those for a deux or large collective structures.

Table VI

Tau and product-moment coefficients of correlation between $E_{Rt2} - E_{Rt1}$ and ΣSI for Time 1 and Time 2, taken separately, for all structures combined and for restricted classes of structures. $N = 47$.

Variable Correlated with $E_{Rt2} - E_{Rt1}$	Tau	r	Level of Confidence	
			tau	r
ΣSI_{t1} (TDC)	.21	.30	.05	.05
ΣSI_{t1} (T)	.22	.29	.05	.05
ΣSI_{t1} (DC)	.14	.21		
ΣSI_{t1} (D)	.09	.17		
ΣSI_{t1} (C)	.18	.24		
ΣSI_{t2} (TDC)	.14	.19		
ΣSI_{t2} (T)	.17	.20		
ΣSI_{t2} (DC)	.10	.15		
ΣSI_{t2} (D)	.05	.15		
ΣSI_{t2} (C)	.11	.12		

Class II Hypotheses with $(E_{Rt2} - E_{Rt1})/E_{Rt1}$ as a Dependent Variable

In the case of Hypotheses II-F -- II-K, in which relative gain in reading rate is taken as the dependent variable, we encounter for the first time coefficients that are not only positive but that are also generally significant. The coefficients for Hypothesis II-F, the basic hypothesis of this group, achieve the .01 level of confidence; those for Hypotheses II-G (restricted to trend structures) and II-H (restricted to combined collective structures) achieve the .01 level; those for Hypothesis II-J (restricted to à deux structures) achieve the

.02 level. The coefficients for Hypothesis II-K (restricted to large collective structures) are positive but do not achieve an acceptable level of confidence. There is evidence, in other words, of the confirmation of four of the five hypotheses in this group.

Additional support for the general hypothesis that relative reading gain is a function of ΣSI comes from the fact that hypotheses in which structures are combined yield higher coefficients than those restricted to particular classes of structures. Hypothesis II-H, combining *à deux* and collective structures, yields higher coefficients than either Hypothesis II-J, which is restricted to *à deux* structures, or Hypothesis II-K, which is restricted to large collective structures. Furthermore, Hypothesis II-F, in which all structures are combined, yields the highest coefficients of all.*

The success with which Hypothesis II-F combines the contribution of all structures in the manifold, through summations of ΣSI , is further attested by the fact that multiple correlational techniques, in which the ΣSI values for particular classes of structures were treated as separate variables, failed to yield coefficients any higher than those reported in Table V for DC and TDC.

In Table VII are reported the coefficients between relative gain in reading rate and ΣSI taken separately for Time 1 and Time 2. These coefficients are comparable to those for Hypotheses II-F -- II-K, in which the ΣSI values for Time 1 and Time 2 are averaged. It may be noted that with one exception all coefficients reach an acceptable level of confidence and particu-

* An apparent exception to the rule that coefficients for combined classes of structures are higher than those for single classes is found in the consistently greater coefficients for hypotheses involving T than for those involving DC. However, in comparison with T, DC should be regarded as a single class, the class of all collective structures.

larly that coefficients involving ΣSI for large collective structures achieve the .05 level of confidence. Hypothesis II-K in which these sums were combined just failed to be confirmed at the .05 level. Correlations in which all structures are combined are again highest, those for trend structures are next highest.

Table VII

Tau and product moment coefficients of correlation between $\frac{E_{Rt2} - E_{Rt1}}{E_{Rt1}}$ and ΣSI for Time 1 and Time 2, taken separately, for all structures combined and for restricted classes of structures. $N = 47$.

Variable Correlated with $\frac{E_{Rt2} - E_{Rt1}}{E_{Rt1}}$	Tau	r	Level of Confidence	
			tau	r
ΣSI_{t1} (TDC)	.27	.40	.01	.01
ΣSI_{t1} (T)	.24	.38	.05	.01
ΣSI_{t1} (DC)	.21	.29	.05	.05
ΣSI_{t1} (D)	.16	.21		
ΣSI_{t1} (C)	.21	.31	.05	.05
ΣSI_{t2} (TDC)	.31	.42	.01	.01
ΣSI_{t2} (T)	.24	.40	.05	.01
ΣSI_{t2} (DC)	.24	.37	.05	.01
ΣSI_{t2} (D)	.19	.37	.05	.01
ΣSI_{t2} (C)	.22	.29	.05	.05

Summary Statement of Results of Class II Hypotheses

Some doubt may remain with respect to the confirmation of those hypotheses of Class II in which absolute gain in reading rate is taken as the

dependent variable. In other words, it is not certain that absolute gain is a function of ΣSI . There are strong grounds for believing, however, that relative gains are a function of ΣSI , whether ΣSI is taken as of Time 1 or Time 2 or as the average of values for Time 1 and Time 2. Furthermore, there are grounds for believing that relative reading gains are a partial function of ΣSI for personality trend structures taken separately, and also a partial function of ΣSI for collective structures taken separately, and also for large and a\`deux structures separately, and that they are more completely a function of the combination, through summation, of all the above values.

Supplementary Results

In the course of the analysis of results, a number of side studies were made, and a few of these are of sufficient interest and relevance to the study as a whole to warrant mention.

Correlation between Time 1 and Time 2 Measures of S and I

None of the methods in current use for determining reliability are very satisfactory in application to measures of S and I. Correlations of split-halves of the manifold of structures or of odd and even numbered structures are not appropriate. Alternate forms of the questions used to get measures of S and I have been tested in previous studies (3,7,8) and have shown satisfactory inter-correlations but in the present study it was not feasible to use independent alternate forms. Test-retest correlations are interpretable as reliability measures only on the assumption of no real changes in the S and I of structures in the manifold. This assumption is not justified on a priori grounds and in the case of the present study would have been a direct contradiction of Class I

hypotheses. Since these hypotheses were not verified, however, and since the distribution of $\sum SI_{t2} - \sum SI_{t1}$ (Table III) shows a mean near zero and a high concentration of differences around the mean, there is empirically a post-hoc and somewhat tenuous justification for regarding the correlations between S measures at Time 1 and Time 2 and between I measures at Time 1 and Time 2 as indicative of the reliability of these measures in the present study.*

The correlations presented below in Table VIII are based on small random samples of ratings of S and I made by subjects in each structure category. The ratings referred to are those made on the same structure at Time 1 and Time 2. The values for N, it will be noted, are different for each coefficient reported and represent the number of structures which fell into the sample on the basis of a pre-established sampling number. Each sample includes ratings made by all subjects in rough proportion to the number of structures rated by each.

If these correlation coefficients are interpreted as indicating the reliability with which S and I were measured, they suggest that the correlations confirming Class II hypotheses would be much higher if the reliability of our measures could be increased. At the same time the confirmation of Class II hypotheses at high levels of confidence makes it clear that at least minimum levels of reliability were achieved and casts additional doubt on the interpretation of the coefficients reported in Table VIII as reliability measures.

* Such reliability, as here defined, would have meaning only for the testing of hypotheses of Class II.

Table VIII

Product-moment coefficients of correlations between individual ratings of single structures at Time 1 and Time 2 on S and I

Variables	N	r	Level of Confidence
$S_{D_{t1}}$ and $S_{D_{t2}}$	173	.61	.001
$S_{C_{t1}}$ and $S_{C_{t2}}$	71	.80	.001
$I_{D_{t1}}$ and $I_{D_{t2}}$	108	.16	
$I_{C_{t1}}$ and $I_{C_{t2}}$	70	.63	.001
$I_{T_{t1}}$ and $I_{T_{t2}}$	73	.39	.01

Note: Since measures of S for trends were obtained only once no correlational index of reliability can be suggested. Rater agreement is a possible measure of reliability but it must be remembered that the subject was asked to list acquaintances who knew him in different capacities and that these acquaintances might therefore have validly different impressions of the amount of spare energy the subject spent in trying to achieve closure of a given trend structure. An idea of the degree of rater agreement can be obtained from the distribution of ratings by different raters on the ten point scale provided for the rating of each trend. The standard deviations of such distributions were calculated for a sample which consisted of one trend selected at random from among those rated for each subject. These sigmas range from 1 to 3.7 with a range in the N of raters from 5 to 13. The average of the sigmas calculated was 2.7 which indicates that while two-thirds of the ratings fall within five scale points of the mean, the other third of the ratings was distributed over the entire remaining part of the scale.

Correlations between Reading Gains and Selected Variables

Correlations between reading gain and ΣI . Once it became clear, on the basis of the results for Class II hypotheses, that reading gain was correlated with ΣSI ,

the question arose as to the relative role of S and I in producing the relationship. On the basis of tau correlations computed between the dependent variables and the sum of the I values for the structures of each subject, it seems clear that I is the major determinant. The coefficients with respect to absolute gain are presented in Table IX, and those for relative gains in Table X.

Table IX

Tau coefficients of correlations between $E_{R_{t2}} - E_{R_{t1}}$ and $\sum I_{t1}$ (Time 1) and $\sum I_{t2}$ (Time 2), for all structures combined and for separate classes of structures (corresponding taus between absolute gains and $\sum SI$, from Table VI, included for purposes of comparison) N = 47

Variable correlated with $E_{R_{t2}} - E_{R_{t1}}$	Tau	Level of Confidence	Corresponding Tau for $\sum SI$
$\sum I_{t1}$ (TDC)	.26	.05	.21
$\sum I_{t1}$ (T)	.28	.01	.22
$\sum I_{t1}$ (DC)	.21	.05	.14
$\sum I_{t1}$ (D)	.04		.09
$\sum I_{t1}$ (C)	.14		.18
$\sum I_{t2}$ (TDC)	.17		.14
$\sum I_{t2}$ (T)	.20	.05	.17
$\sum I_{t2}$ (DC)	.10		.10
$\sum I_{t2}$ (D)	.08		.05
$\sum I_{t2}$ (C)	.15		.11

Table X

Tau coefficients of correlation between $(E_{Rt2} - E_{Rt1})/E_{Rt1}$ and ΣI_{t1} (Time 1) and ΣI_{t2} (Time 2), for all structures combined and for separate classes of structures (corresponding taus between relative gain and ΣSI , from Table VII, included for purposes of comparison)
N = 47

Variable correlated with $\frac{E_{Rt2} - E_{Rt1}}{E_{Rt1}}$	Tau	Level of Confidence	Corresponding Tau for ΣSI
ΣI_{t1} (TDC)	.26	.05	.27
ΣI_{t1} (T)	.28	.01	.24
ΣI_{t1} (DC)	.17		.21
ΣI_{t1} (D)	.10		.16
ΣI_{t1} (C)	.12		.21
ΣI_{t2} (TDC)	.30	.01	.31
ΣI_{t2} (T)	.29	.01	.24
ΣI_{t2} (DC)	.24	.05	.24
ΣI_{t2} (D)	.22	.05	.19
ΣI_{t2} (C)	.23	.05	.22

It will be noted that most of the coefficients involving ΣI are almost as high as those for ΣSI and that some are higher. Coefficients involving ΣSI show greatest superiority for collective structure classes and least for trend structures.

Correlations between reading gains and measures of practice. A number of correlations were computed between the dependent variables and various measures of

amount of practice during the course, including total number of slides flashed, and total number of words read (correcting for rate of reading). The coefficients were all in the vicinity of zero.

Correlations between reading gains and vocabulary scores. The tau coefficient of correlation between vocabulary scores of the subjects and their relative reading gains was found to be .04.*

Correlations between reading gains and age. The tau coefficient of correlation between age of subjects and their relative reading gains was found to be -.13.*

* The tau coefficients reported for the correlation of reading gains with vocabulary scores and with age obviously are not significant. These variables, however, when included together with initial reading rate and other variables in a multiple correlation formula have been shown to aid significantly in the prediction of the final reading rate of 240 previous subjects of the Air Force reading laboratory. There is reason to believe therefore that vocabulary and age play a significant, if minor, part in determining reading gains.

The multiple correlation study of the 240 previous subjects was conducted by John Bowen of the Department of Psychology, University of Maryland, in the course of preparation for the present study.

Discussion

This section of the report includes discussion of the following topics:

1. Absolute reading rate gain versus relative reading rate gain as dependent variables.
2. Failure of Class I hypotheses.
3. Bearing of results on Event-Structure Theory.
4. Interpretation of results in terms of the nature and determinants of learning.
5. Suggestions for future research arising from study.

Absolute Reading Gains Versus Relative Reading Gains

Analysis of the coefficients computed for the twenty hypotheses of the study reveals that nine of the ten coefficients for hypotheses which have relative reading gains as the dependent variable were higher than those for the corresponding hypotheses with absolute reading gains as the dependent variable. Our greater relative success with $\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}}$ than with $E_{R_{t2}} - E_{R_{t1}}$ as a dependent variable measure would seem clearly to be the result of compensating for the fact that those subjects with higher initial rates of reading tended to improve more than those with lower initial rates. (The tau coefficient of correlation between $E_{R_{t1}}$ and $E_{R_{t2}} - E_{R_{t1}}$, as reported in Table II, was +.20, whereas the coefficient between initial reading rate and $\frac{E_{R_{t2}} - E_{R_{t1}}}{E_{R_{t1}}}$ was -.10.) Multiple correlations including ΣSI and $E_{R_{t1}}$ as predictors of absolute reading gains produce coefficients approximately as high as those reported for Hypotheses II-F -- K which relate relative reading gains with ΣSI .

Failure of Class I Hypotheses

The failure to confirm hypotheses of Class I, regardless of the measures

taken of the dependent variable, may be due to the fact that the hypotheses are incorrect. Improvement in reading rate performance between Times 1 and 2 may not be a function of increases in the energy, between Times 1 and 2, derived by way of interstructurance from the subject's personality trend and collective structures.

It is possible, however, that hypotheses of Class I failed to be confirmed because of inadequacies in their testing. Two possible inadequacies stand out. The first is that the duration of the course (six weeks) was perhaps not sufficient to give new S or I values a chance to become established. It has been pointed out (in Table III) that the obtained differences were concentrated around a mean near zero. The second is that the measures of S or I, or both, were too unreliable to reflect accurately the small differences between ΣSI_{t1} and ΣSI_{t2} .

Support the Study Provides for Event-Structure Theory

The success of hypotheses of Class II may be interpreted as supporting Event-Structure Theory in several ways.

In the first place, the results with respect to Class II hypotheses mean that another link has been added to a chain of studies which have been based on the Structural Energetics Formula and which have yielded at least some confirmation of the formula (2,3,4,5,6,7,8,9).

The results also provide further confirmation of the fact that the Structural Energetics Formula applies to learning phenomena, as well as to the other phenomena studied so far (e.g.. conformity behavior, attitude ratings, trait ratings). In this respect, the study is in a class with Stroud's doctoral dissertation experiment on prediction of improvement in composition writing.(5)

Support for the validity of the Structural Energics Formula is found as much in the consistency of the results for all hypotheses of Class II as in the level of significance achieved by the higher coefficients of correlation. All coefficients were positive, and most of them either achieved or approached an acceptable level of confidence. The general hypothesis that gain in reading rate is a function of ΣSI was borne out for all structures combined, and for each class of structures taken separately. It was borne out whether ΣSI was taken as of Time 1, Time 2, or as an average for both Time 1 and Time 2. Both rank-difference (τ) and product-moment correlations confirmed the hypothesis, to some extent at least, whether improvement was measured in terms of absolute gain or relative gain in reading rate.

Another important consideration is that the coefficients tended to increase in magnitude as classes of structures were combined through summation of their ΣSI values. Coefficients for hypotheses embracing \grave{a} deux collective and large collective structures tended to be larger than those for hypotheses concerned solely with \grave{a} deux or large collective structures. Coefficients for hypotheses embracing personality trend, \grave{a} deux and large collective structures, were, with one exception, the largest of all. Furthermore these latter coefficients were found to be as large as those resulting from multiple correlation methods. In other words, the combining of ΣSI values on the basis of the summative operations indicated by the Structural Energics Formula was as successful as their combination through strictly statistical means. This should be expected because in I we have a pre-estimate of correlation itself.

It is worth noting that the test of the hypotheses was a rigorous one. The test took into account the raw measures (as combined in the formula) for all subjects, rather than measures derived for "high" or "low" groups of sub-

jects, and it involved a group of subjects who were fairly homogeneous with respect to each of the variables in question.

There remains the question whether the confirmation of Class II hypotheses can be explained on some basis other than the validity of the Structural Energics Formula and its underlying theory of Event-Structure. The most likely alternative explanation, principally because of the results listed in Tables IX and X, would appear to be in terms of the measures of I employed. A plausible case might be made that individuals have the ability to predict their improvement through practice by estimating the effect of this practice on their involvements in specific values, personal relationships and institutions. The data shown in Tables IX and X verify the assumption that our subjects did, in a sense, have this ability, since their performance differences were shown to be significantly correlated with ΣI alone. It was of course a necessary assumption of the methodology employed in this study that this ability would be demonstrated to a degree. It is worth recalling at this point, however, that in previous studies based on the Structural Energics formula, interstructurance ratings were made not by the research subjects but by experts personally unfamiliar with these subjects. In these studies also, as has been indicated, confirmation of hypotheses deduced from Event-Structure Theory were to some degree confirmed. It is unquestionably a necessary assumption of the methods used in Event-Structure research to date that human beings -- but not necessarily the experimental subjects -- are capable of making valid judgments of interstructurance probabilities.

The real question, however, is not whether the above assumption is necessary but whether it is sufficient to account for the confirmation of Event-Structure hypotheses. A general comparison of the correlation coefficients

of ΣI and ΣSI with reading rate gains seems to show that for the present study this is indeed the case. But this demonstration is clearly post hoc; and there appear to be compelling theoretical and empirical grounds for rejecting its generalization. It makes no sense to speak of predicting or demonstrating relationships in terms of probability estimates unless something is known or inferred about the magnitudes to which these estimates refer, and measures of I are simply probability estimates. If when combined through summation the sums correlate significantly with other measures, as they did in this case, it must be because the assumption of equal weighting implicit in the summation process does not completely contradict the facts. The facts compatible with equal weighting might be that the S values of the structures in question were: 1) constant, 2) perfectly correlated with the I values, and 3) perfectly random with respect to the I values. The first possibility can be dismissed but approximations to either or both of the second and third could account for the correlation coefficients obtained. It is possible although it seems highly unlikely that in fact structurance and interstructurance-probability are in general either highly correlated or completely uncorrelated. It seems more likely that one or both of these conditions might be approximated with respect to the manifolds of particular structures -- possibly for a structure like a reading rate improvement course. It is also possible that the measurement methods used or the particular circumstances of their use in this study might lead to either unusually high correlation of S and I or to a random distribution of S with respect to I . Further analysis of our data and further research on the questions which are raised here is certainly called for.

None of the possibilities which have been discussed would, if verified,

involve any fundamental changes in the Structural Energetics Formula. Prediction of amounts of energy which are implied in the equation $E = \sum SI$ would always require values for S as well as I although if certain relations were found to hold uniformly between S and I the formula and the associated methodology might be simplified for purposes of statistical prediction.

We conclude that, although a parsimonious explanation of the confirmation of Class II hypotheses can be made post hoc on the basis of $\sum I$, such an explanation lacks theoretical meaning, and also that the empirical facts which would make its generalization plausible are not only unverified but improbable of verification. Since the hypotheses were deduced from Event-Structure Theory, verified by methods derived from the theory, and since this verification can be satisfactorily rationalized only in terms of these methods, the results of the study should be held to lend support to the validity of the Structural Energetics Formula and underlying Event-Structure concepts.

Interpretation of Results in Terms of the Nature and the Determinants of Learning

The failure of Class I hypotheses and the confirmation of hypotheses of Class II suggests that the average level of manifold energy is important in determining the energies of the structure that accrue during, or as a result of, practice and that changes in the level of manifold energy during the practice period are not. Before generalizing from these results it should be recognized that reading rate improvement has certain characteristics which are not possessed by all types of learning in the same degree. It is characterized by practice, that is, by repetition of behavioral sequences which are not readily distinguished from each other by the learner or by the observer. In contrast many other kinds of learning appear to occur in single trials, i.e.,

once the "correct" sequence of behavior has occurred, its recurrence becomes highly predictable. "Learning" a body of historical facts for example does not seem to require practice to the same degree that reading rate improvement does.

It seems possible that Class II hypotheses will be confirmed only for learning in which practice is a principal element and that learning for which this is not the case will be better predicted by hypotheses of Class I. Learning which involves a minimum of practice may, in other words, be associated with corresponding increases in the amount of energy from the individual's manifold which is available for the learned act. This kind of learning could be interpreted in terms of an increase in the interstructurance increment of manifold structures and the structure of the learned act.

But how shall learning be interpreted which appears to result primarily from practice and which is predictable, as in the case of this study, not from changes in energy available from the individual's manifold of structures but from the average amount of energy available during practice? It should be recalled that no evidence was found in the study that the number of practice trials was associated either with sum of SI or with increase in reading rate.

Two lines of interpretation suggest themselves. One of these refers to the inner structure of the reading or reading improvement cycles, to what was referred to in the introductory exposition of the Structural Energies Formula as the intrinsic energy of the dependent variable structure and which was labelled S. It is plausible that repetition of the reading cycle under circumstances designed to maximize speed and eye-span might be accompanied by increases in either the average energy or the interstructurance probability of neuro-physiological elements of the reading cycle and that the probability

and magnitude of such increases would be proportional to the average energies available from the manifold of the individual's structures (our ΣSI) at each repetition of the reading cycle.

Another interpretation is possible which involves no assumptions of change in the reading structure but which depends upon the spacing of practice periods. Each practice period and each repetition of the reading cycle can be looked upon as a concentration in time-space of the energy units which enter into it. This concentration is in all likelihood not instantaneous but rather is a gradual build-up of energy reaching a peak in the time-space region of the occurrence of the practice period and gradually tapering off from this peak. If practice periods are spaced closely enough in time there will be, at the time a given practice period occurs, not only the energy units building up to a peak at this time but also an increment of energy units from the tapering off of a previous peak. The added energy will, if practice periods are spaced closely enough, include a series of increments from the tapering off of all previous energy concentrations of previous practice periods.

The first practice period in the time series would of course provide decreasing amounts of energy to each succeeding period, as the time interval between them increased, and eventually its contributions to succeeding practice periods would cease. At this point, if the practice periods were evenly spaced, the maximum number of concentrations from preceding practice periods would be contributing energy to the current practice period.

The amount of energy made available by any given practice period to subsequent practice periods would logically be a function not only of the time intervals involved, but also of the energy derived through its immediate interstructurance with structures in its manifold, or sum of SI . If ΣSI

were to remain fairly constant for the structures in the series, the total increment in energy from previous practice periods to subsequent ones would then be a function of an average ΣSI for the total training period.

The preceding interpretations suggest what may be fruitful lines of research in learning. Perhaps the major contribution, however, that this study makes to the further understanding of learning lies in its suggestion that the learning process can fruitfully be regarded as structures of a particular sort, structures having to do with what are referred to as the "correct" response or the "correct" method occurring more rapidly and more frequently in time and space, this greater rapidity and frequency being a function of the way the structure "gears in" with important, on-going structures of the individual so as to derive energy from them. That is to say that more energy goes into the structures that have high positive interstructuranc with high energy manifold structures than into other structures. The former are from the learning point of view the "correct" structures.

To summarize, this study demonstrates an approach to learning from the point of view of motivation, and shows one way of conceiving and experimentally studying the motivational basis of learning.

Critique and Suggestions for Future Research

The confirmation of Class II hypotheses provided by the results indicates that in general the methods and instruments employed in testing these hypotheses were adequate, despite the limited reliability of the measures yielded by the latter. In view of the failure of Class I hypotheses, however, it is interesting to speculate on how the study might have been planned and conducted differently so as to provide perhaps a fairer test of the hypotheses.

If the speculation is not to be idle, its fruits must of course be incorporated in future studies.

It has been mentioned that one of the possible reasons for the failure of Class I hypotheses was the relatively short duration of the reading improvement course. It might be wise in another test of the hypotheses to choose a learning situation which extends over a much longer period of time, making it more possible for changes in S and I to occur.

Along these same lines, it might be well to choose a program of learning in which the individual practice periods are fewer and spaced further apart in time, in order to minimize the possible increment of energy resulting simply from the repeated occurrence of practice structures, as argued in the rationale of Class II hypotheses.

It might also be profitable to select as a dependent variable structure a training program which is not quite so obviously interstructurant at the outset with at least some of the subjects' trend and collective structures. Such interstructurance is indicated by the fact that the subjects had all volunteered to take the reading improvement course, apparently perceiving it as having relevance to their structures. If one were to work with a training structure having less relevance at the outset, there might be more of an opportunity for increments in ΣSI to occur.

Furthermore, use of a more heterogeneous cross-section sample of subjects, exhibiting wider ranges both of dependent variable measures and ΣSI values might work more fairly in testing the hypotheses.

Finally, it would seem worthwhile to test the hypotheses for a learning structure in which more emphasis is placed, in the training, on the matter of the

perceived relevance of the learning structure to the trend and collective structures of the subjects. This would possibly facilitate the increases in I.

The preceding suggestions all rest on the assumption that Class I hypotheses may be valid for an important class of learning situations. It is worth noting that the suggestions are not restrictive but tend to describe learning situations of a more general character than the one dealt with in this study.

A number of other suggestions for future research have been made or have been implicit in the preceding data and discussion. A few of these deserve to be made more explicit. The present design might be systematically repeated, testing both Class I and Class II hypotheses, in a series of learning situations varying primarily in the amount of practice involved. This might lead to important generalizations with respect to the relative role of increments due to practice and increments due to increased interstructurance of the learning structure with structures in the manifold.

The suggestion was made that learning involving regular practice could be interpreted on the basis of an overlapping of energetic concentrations which reach a peak in the practice period. This might be investigated in a preliminary way, using existing data from studies in which the spacing of practice and the degree of motivation have both been varied.

The methodological problem that stands out in the present study has to do with the statistical relationship of measures of S and I. This seems to call for a design in which the relative role of S and I can be appraised in correlations of ΣSI with a series of dependent variables, and in which inter-correlations of S and I measures can be systematically obtained.

Summary

The research study described in this report was designed to test hypotheses with respect to learning based on the Structural Energetics Formula, which forms a central part of F. H. Allport's Event-Structure Theory. Improvement in reading rate on the part of students enrolled in an Air Force reading improvement course was taken as the dependent variable of all hypotheses. According to hypotheses of Class I, reading gains from the first week to the last week in the course, whether measured on an absolute or relative basis, are a function of increases in the energy expended by the subject in the course (structure) at these two times respectively, on the basis of its immediate interstructurance with some or all of his personality trend, à deux collective (personal relationship), and large collective (institutional) structures. These hypotheses were not confirmed.

According to Class II hypotheses, reading gains -- absolute or relative -- are a function of the average interstructurance of the reading improvement course with some or all of the subjects' personality trend, à deux collective or large collective structures, for the period of time covered by the course. The results indicate some confirmation of all of these hypotheses, more for those with relative reading gains rather than absolute reading gains as a dependent variable, and especially for those in which structures are combined (both types of collective structure, and collective structures plus personality trend structures).

The results are interpreted as providing additional support for Event-Structure Theory, as indicating the contribution that Event-Structure Theory can make to the understanding and study of learning phenomena, and as suggesting future research projects.

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